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PRODUCTION ENGINEERING MEASURE (PEM) MANUFACTURING METHODS AND --ETC(U)

JAN 77 W B HARRISON, L HILTNER, W KAMMEYER

DAAB07-76-C-0008

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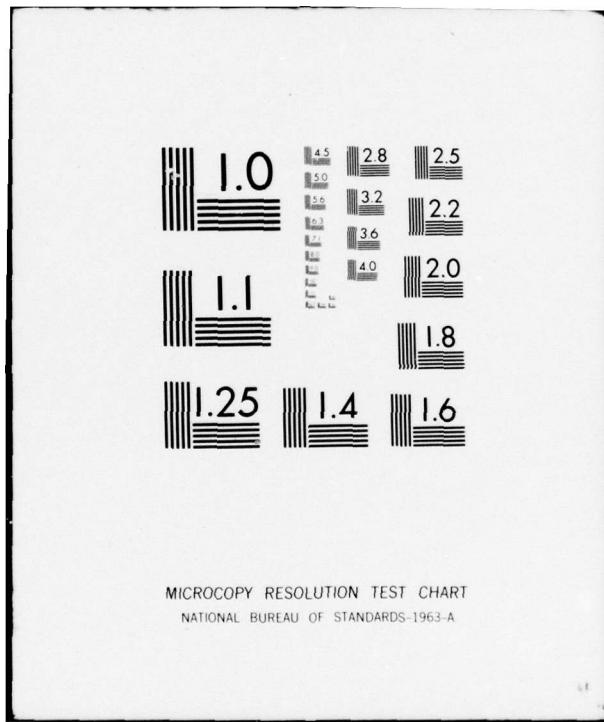
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SIXTH QUARTERLY PROGRESS REPORT  
PRODUCTION ENGINEERING MEASURE (PEM)

MANUFACTURING METHODS AND TECHNIQUES  
FOR PIEZOELECTRIC TRANSFORMERS

CONTRACT DAAB07-76-C-0008

October 14, 1976, to January 14, 1977

PLACED BY:  
PRODUCTION DIVISION, PROCUREMENT AND  
PRODUCTION DIRECTORATE, USAECOM  
FORT MONMOUTH, NEW JERSEY



CONTRACTOR  
HONEYWELL INC.  
GOVERNMENT AND AERONAUTICAL PRODUCTS DIVISION  
CERAMICS CENTER  
GOLDEN VALLEY, MINNESOTA

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## SIXTH QUARTERLY REPORT

**CONTRACT NO.**

DAAB07-76-C-0008  
Manufacturing Methods and Techniques  
for Piezoelectric Transformers

**PERIOD COVERED:**

October 14, 1976 to January 14, 1977

**PREPARED BY:**

W. Harrison  
L. Hiltner  
W. Kammeyer

**OBJECT OF STUDY:**

The objective of this contract is to establish a production capability for 18mm and 25mm piezoelectric ceramic transformers with all required manufacturing methods, test procedures and production tooling for high production rates. These transformers are to be used in conjunction with a power supply for operating night vision image intensifier tubes.

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## **ABSTRACT**

**The Sixth Quarterly Report for Contract DAAB07-76-C-0008 describes the progress and status of this program to establish a cost-effective production capability for 18mm and 25mm piezoelectric ceramic transformers. The construction status for the 30 confirmatory 18mm and 25mm PETs is reviewed in this report.**

PURPOSE

This Production Engineering Measure (PEM) contract covers all of the tooling, test methods, package designs, mounting techniques, interconnection techniques and other manufacturing methods and techniques required for eventual production of 18mm and 25mm piezoelectric transformers. These units are to be used with a power supply to improve the performance and reduce cost for image intensifier tubes used in various night vision devices.

## TABLE OF CONTENTS

Section		Page
	PURPOSE . . . . .	v
I	APPROACH . . . . .	1
II	PROCESS REVIEW . . . . .	2
III	STATUS AND FUTURE WORK . . . . .	7
	A. Task 1-6 . . . . .	7
	B. Task 7 - Polarization Tooling . . . . .	7
	C. Task 8-18 . . . . .	7
	D. Task 19 - Confirmatory Build . . . . .	7
IV	CONCLUSIONS . . . . .	10
V	RECOMMENDATIONS . . . . .	11
VI	REPORTS . . . . .	12
VII	IDENTIFICATION OF PERSONNEL . . . . .	13
A	APPENDIX A DISTRIBUTION LIST . . . . .	A-1

#### **LIST OF ILLUSTRATIONS**

<b>Figure</b>		<b>Page</b>
1	30 kV Polarization Station . . . . .	3
2	18 and 25mm Poling Fixture . . . . .	5
3	Program Status Against Schedule . . . . .	8

#### **LIST OF TABLES**

<b>Table</b>		<b>Page</b>
1	Operation Status . . . . .	9

SECTION I  
APPROACH

Our approach to both the 18mm and 25mm PET designs, its advantages and the analytical method used to determine performance of these transformers, was discussed in the first quarterly report<sup>(1)</sup>.

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(1) First Quarterly Progress Report, Production Engineering Measures (PEM), Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, July 14, 1975, to October 14, 1975.

## SECTION II PROCESS REVIEW

All processing steps on this program have been documented previously<sup>(1)(2)(3)(4)(5)</sup> for the 18mm and 25mm PETs. Only minor differences are expected to be made in the confirmatory build process. Those that have been made are described below:

### OP 120 Polarization

#### A. Materials

1. Peanut Oil

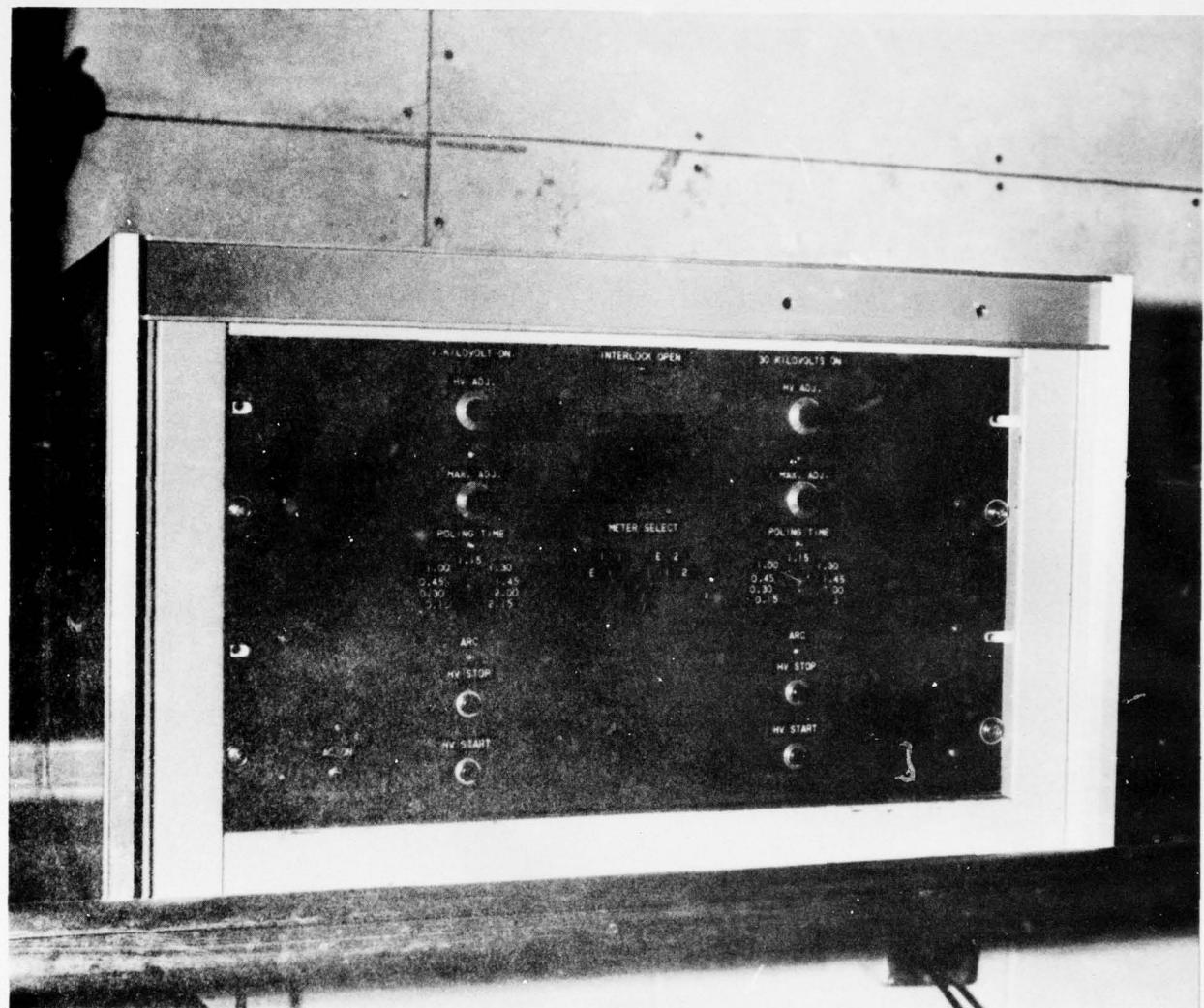
#### B. Tools and Fixtures

1. 30 kV polarization station (see Figure 1a)
2. Poling fixture (see Figure 2)
3. Chlorethane degreaser

#### C. Procedure

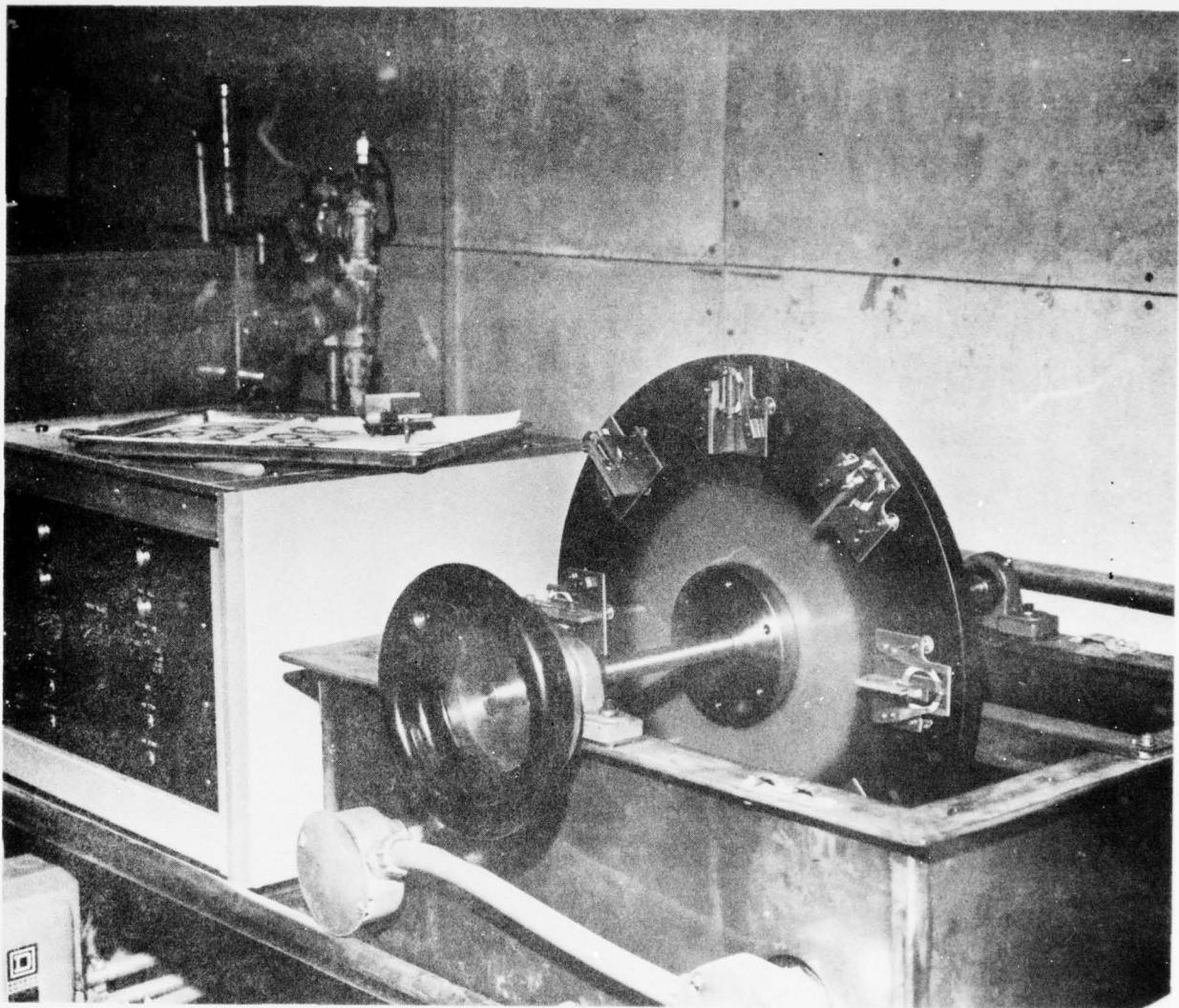
1. Place 18mm or 25mm elements in poling fixture with positive and negative leads of primary electrodes connected to external leads.
2. Rotate fixture in 165°C oil bath to next station. Voltage is applied to parts in oil.

- 
- (2) Second Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, October 14, 1975, to January 14, 1976.
  - (3) Third Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C0008, January 14, 1976, to April 14, 1976.
  - (4) Fourth Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, April 14, 1976, to July 14, 1976.
  - (5) Fifth Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, July 14, 1976, to October 14, 1976.



a. 30 kV Polarization Controls

Figure 1. 30 kV Polarization Station



b. Rotary Poling Station

Figure 1. 30 kV Polarization Station (Concluded)

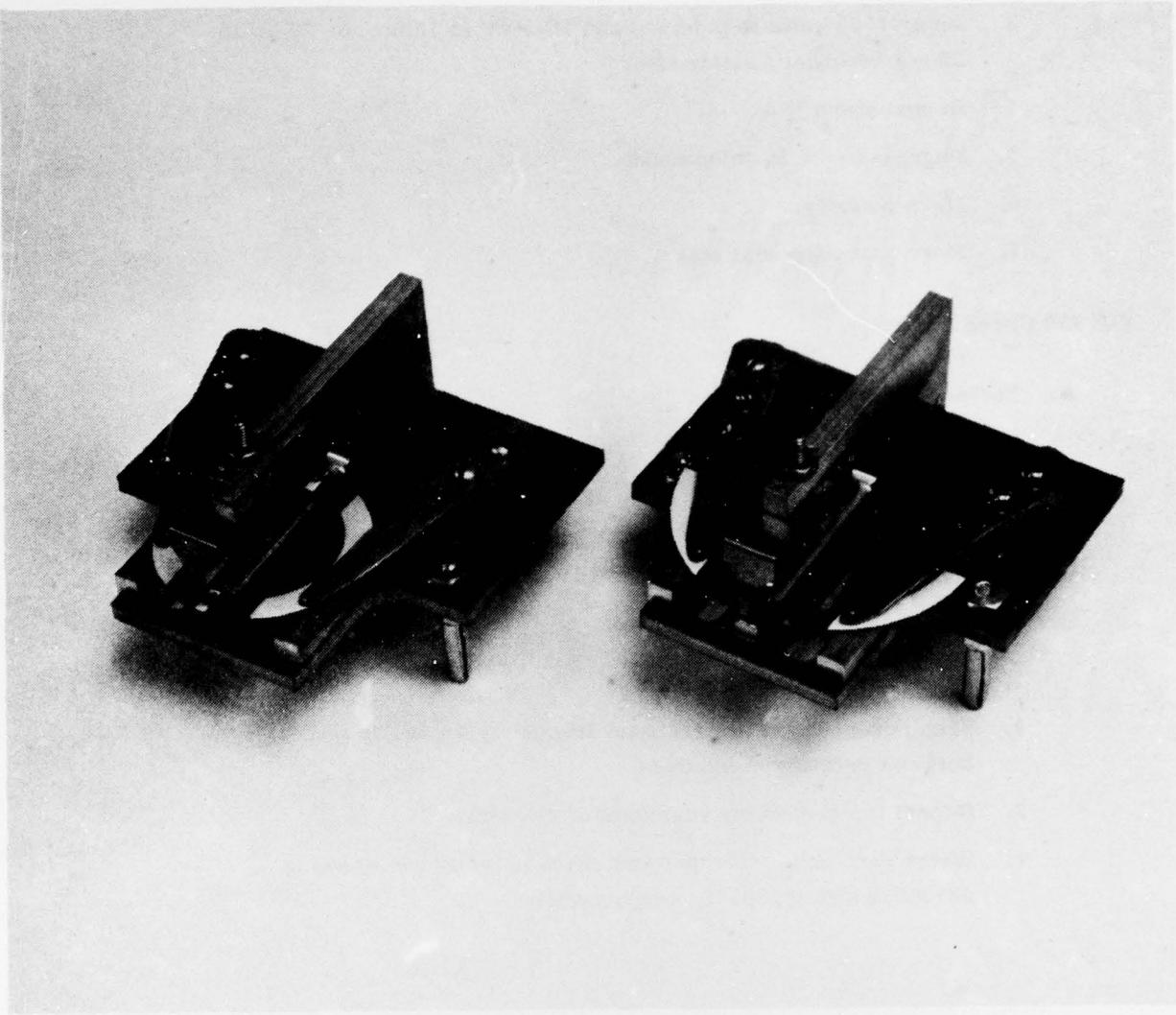


Figure 2. 18 and 25mm Poling Fixture

3. Apply 1500 volts to primary and 16.5 kV to 18mm, or 27 kV to 25mm secondary electrodes.
4. Repeat steps 1-3.
5. Degrease part in chlorethane.
6. Mark polarity.
7. Store parts for next stage.

#### OP 130 Check Polarity

##### A. Tools and Fixtures

1.  $d_{33}$  Checker
2. Sample Holder
3. Frequency Bridge

##### B. Procedure

1. Place part in sample holder
2. Scan resonant and antiresonant frequency for  $f_a$ ,  $f_r$  and  $f_a/f_r$  between primary electrodes.
3. Repeat for secondary segments of element.
4. Insert part in  $d_{33}$  Checker and check polarity per drawing 28100510 and 28100571, respectively.

### SECTION III STATUS AND FUTURE WORK

This section describes the status of work against the various tasks outlined in Figure 3 that were active during this sixth quarter of the program. Approval to start the confirmatory build phase was requested October 7, 1976, and verbally received December 2, 1976.

#### A. TASK 1-6.

Work completed previously.

#### B. TASK 7 - POLARIZATION TOOLING

Now that both the 18mm and 25mm designs have been established, the poling station design has been completed. Figure 1a shows the poling supply and Figure 1b the rotary poling station. Figure 2 shows the construction of the 18mm and 25mm poling fixture used in the rotary station. Parts are individually poled, as discussed in Section II, at two levels of voltage at the two poling stations in the rotary station. This completes the work on this task.

#### C. TASK 8-18

Work completed previously.

#### D. TASK 19 - CONFIRMATORY BUILD

As indicated above, verbal approval to start the confirmatory build phase of this program was received 12/2/76 and confirmed on 12/22/76. The status of each operation, by operation number, for the 18mm and 25mm PET assemblies appears in Table I.

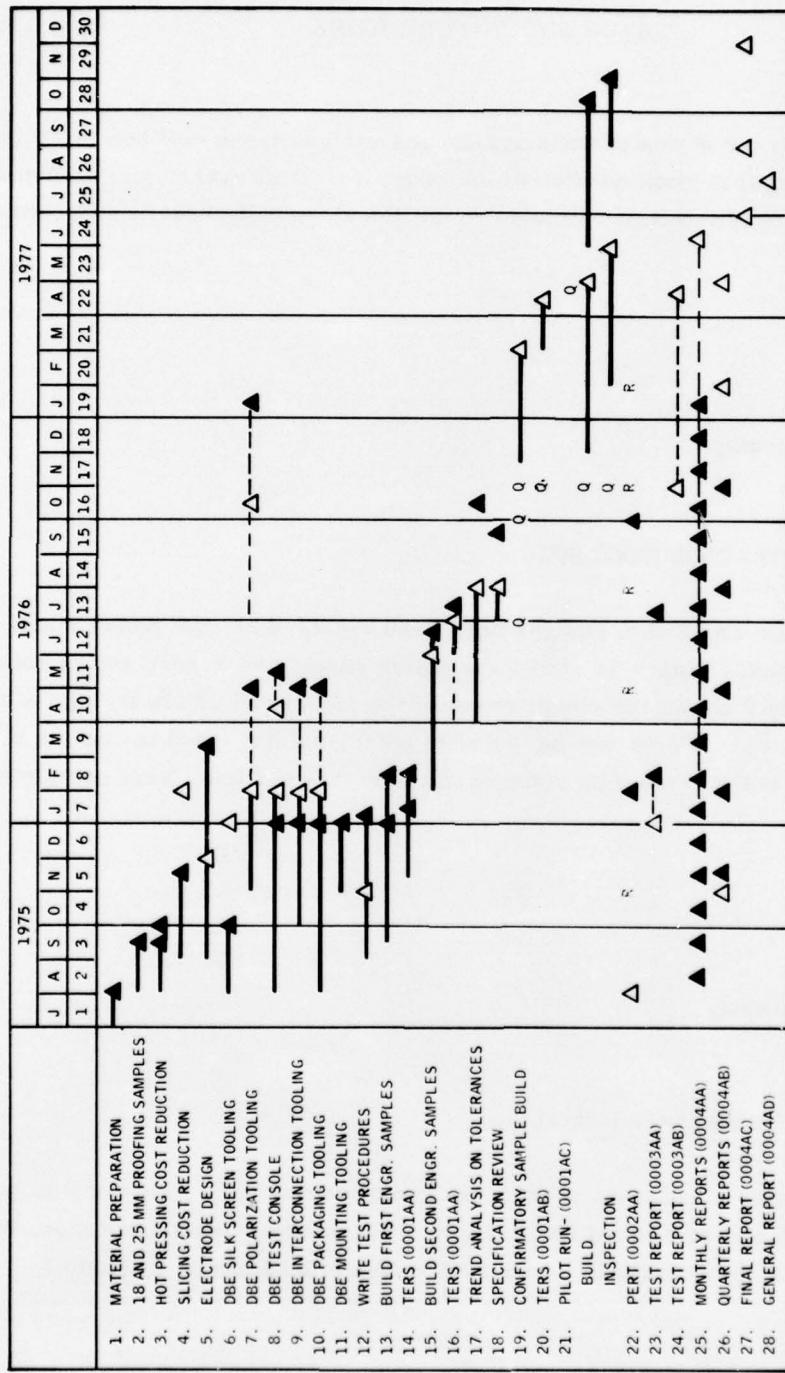


Figure 3. Program Status Against Schedule

The process for assembly of the 18mm units went quite smoothly; however, the 25mm elements assembly proved to be a major problem and quite time-consuming. The unproven, lower cost approach proposed for the confirmatory build whereby the top case was used as the bonding fixture was not workable. The case did not give adequate support to the first element inserted in the package and the setup time of the epoxy was too short. This resulted in cracking of the first element and poor control of the bond thickness between elements. Improvements in the thickness control of the bond was obtained by bonding three elements in an external bonding fixture and then bonding these to the first element in the package. However, of the 40 units made by this process, only 18 satisfactory units were obtained. Cracking of elements appeared to be the main cause of failure. Further efforts are being made to improve this process for the final build of 25mm confirmatory units.

Table 1. Operation Status

Description	Operation No.	18mm		25mm	
		Dwg. No.	Status	Dwg. No.	Status
Ceramic Elements	OP 010-130	28100576	Complete	28100571	Complete
Base Package Preparation	OP 140	28100578	Complete	28100568	Complete
Top Package Preparation	OP 140	28100577	Complete	28100569	Complete
Top Case Assembly	OP 150-160	28100560	Complete	28100561	18 Complete
Final Assembly	OP 170	28100560	Complete	28100561	12 Complete
Testing and Evaluation	OP 180	28100560	35 in Progress	28100561	9 in Progress

## **SECTION IV**

### **CONCLUSIONS**

**The 18mm packaging process appears to be amenable to production approaches; however, additional efforts on the 25mm PET assembly approach are needed before it qualifies as a production assembly process.**

SECTION V  
RECOMMENDATIONS

**Additional 25mm units need to be built by alternate approaches to determine means of improving the reliability of these confirmatory-produced PETs.**

**SECTION VI  
REPORTS**

**The fifth quarterly report on this program was approved and has been published and distributed during this report period. No other reports or publications have been made on this program.**

SECTION VII  
IDENTIFICATION OF PERSONNEL

During the sixth quarter of this program, the following personnel worked the indicated hours in their area of responsibility. No new professional persons, whose backgrounds have not been given previously<sup>(1)(2)</sup>, were used.

<u>Individual</u>	<u>Responsibility</u>	<u>Hours</u>
W. B. Harrison*	Program Manager	26
W. H. Kammeyer*	Production Engineer, Ceramic Manufacture and PET Assembly	21
L. F. Hiltner*	Quality Engineer	40
M. P. Murphy	Ceramic Technician Ceramic Manufacturing	17
R. Ripley	Insp. PET Testing	14
R. Erickson	Drafting	3

\*Backgrounds given in First and Second Quarterly Reports

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